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Forest Insect and Disease Management Annual Report

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Region



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FOREST INSECT AND DISEASE MANAGEMENT
ANNUAL REPORT
ROCKY MOUNTAIN REGION
1978

by

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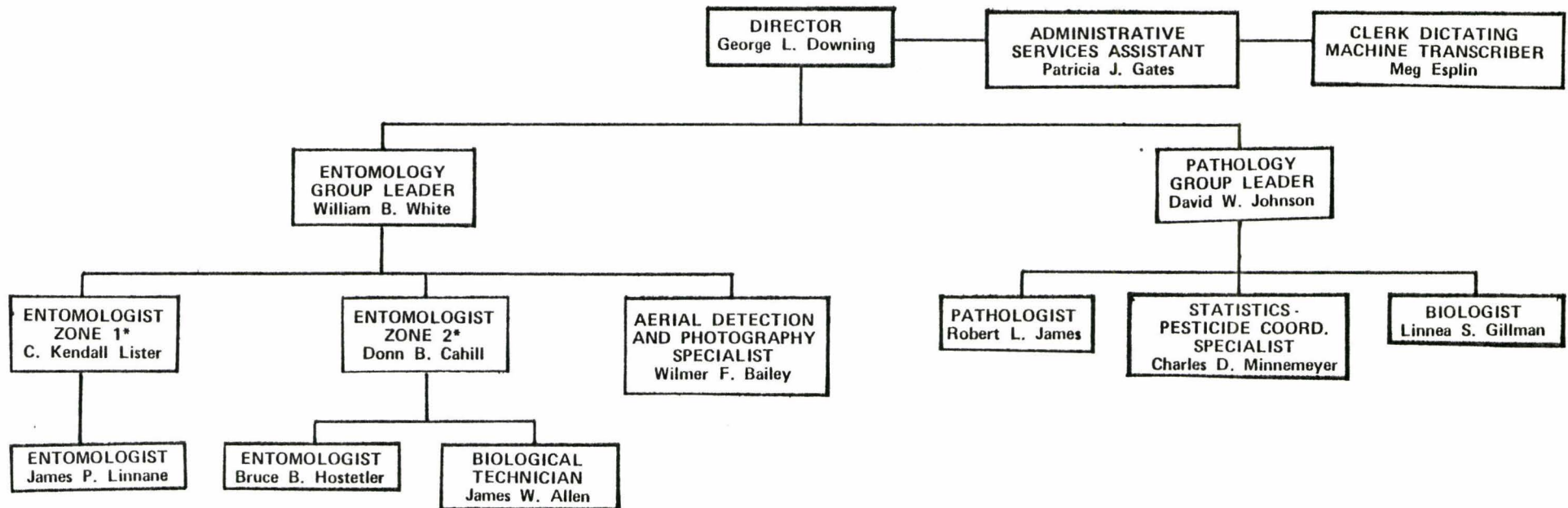
INTRODUCTION

Forest Insect and Disease Management (FI&DM) is directed by the Cooperative Forestry Assistance Act of 1978 (Public Law 95-313) to be responsible, on lands administered by the Forest Service, for prevention, detection, evaluation and suppression of forest insects and diseases. On lands administered by other Federal agencies FI&DM is responsible for detection surveys and biological evaluations and for providing technical advice to land managers in forest insect and disease prevention and suppression. On non-Federal land, state agencies and private landowners are responsible for forest insect and disease control. A number of Federal forest management programs are available to assist state and private landowners, both financially and technically. These programs are administered through cooperative agreements with the states.

Ground and aerial surveys throughout the Region in 1978 were used to detect forest insect and disease infestations. Some surveys were conducted in cooperation with the states of Colorado, Kansas, Nebraska, South Dakota, and Wyoming. In the Appendix, a map shows the distribution of several of the major insects and diseases in the Region.

Additional information on specific insect and disease pests may be requested from the FI&DM Staff located at the Regional Office in Lakewood, Colorado. The current organization of the FI&DM Staff is displayed on the following page.

FOREST INSECT AND DISEASE MANAGEMENT
ORGANIZATIONAL CHART



* Zone 1 -- Colorado; Zone 2 -- Kansas, Nebraska, South Dakota and Wyoming

INSECT AND DISEASE CONDITIONS IN BRIEF

The mountain pine beetle was the most destructive forest insect pest within the Region. The beetle continued to inflict substantial tree losses in ponderosa pine stands in the Colorado Front Range and in the Black Hills of South Dakota. Infestations in lodgepole pine and limber pine continued on the Shoshone National Forest in Wyoming. Programs to suppress beetle activities and improve forest stand conditions are ongoing in Colorado and in the Black Hills. A vegetative management pilot project was undertaken by federal, state, and local governments in Colorado.

The western spruce budworm continued to cause serious defoliation to Douglas-fir and white fir within the Region. A major infestation existed in the Colorado Front Range with smaller outbreaks on the San Juan National Forest, Colorado and the Shoshone National Forest, Wyoming. The epidemic persisted particularly on the northern Front Range of Colorado, where damage from several consecutive years of defoliation was increasingly evident.

Dwarf mistletoes continued to cause the most important diseases. They were especially damaging to lodgepole pine in Colorado and Wyoming and ponderosa pine in Colorado. Comandra rust remained as one of the major problems of lodgepole pine in Wyoming.

Important diseases in the Great Plains included decline of jack pine in the Nebraska National Forest, heartrot of green ash in shelterbelts, western gall rust in the Black Hills of South Dakota, Cytospora canker of eastern cottonwood plantations, Dutch elm disease, Diplodia tip blight, and oak wilt. Numerous other diseases of lesser importance were reported.

Colorado participated in the Federal Dutch Elm Disease Control Demonstration Project. The State conducted integrated control programs aimed at reducing losses to elm populations. During 1978, 296 confirmed cases of Dutch elm disease were reported in four project communities (Canon City, La Junta, Yuma, and Eaton).

Annosus root rot was found on white fir in southern Colorado. Shoestring root rot and black stain root disease were common on lodgepole pine reproduction and pinyon, in Colorado.

Broom rusts of spruce and true fir were found throughout western Colorado. Levels of disease incidence varied widely among different stands.

STATUS OF INSECTS

BARK BEETLES

MOUNTAIN PINE BEETLE: *Dendroctonus ponderosae* Hopkins

This insect continued to be a significant pest to ponderosa pine in the Front Range of Colorado, the Black Hills of South Dakota, and the east slope of the Bighorn Mountains of Wyoming. The beetle also caused losses in lodgepole pine and limber pine on the Shoshone National Forest near South Pass City and Atlantic City, Wyoming.

In the Colorado Front Range, an estimated 1.5 million ponderosa pine trees within 235,000 hectares (580,000 acres) die annually as a result of the current mountain pine beetle epidemic. However, brood surveys indicated a decreasing trend in beetle populations in the Arapaho and Roosevelt National Forests, but static conditions in Rocky Mountain National Park and the Pike and San Isabel National Forests.

The mountain pine beetle situation in the Black Hills continued to be serious. Brood surveys indicated a slightly increasing trend in the northern Black Hills and a static to decreasing trend in the southern Black Hills. Results of an attack survey indicated a 1 to .68 ratio of old to new attacks. However, attack surveys in the Lead-Deadwood Exemption Area indicated a 1 to 2 ratio.

Ponderosa pine stands along the east slope of the Bighorn Mountains suffered mortality in scattered groups of 10 to 200 trees. Surveys indicated an increasing beetle population.

Several mountain pine beetle suppression programs were ongoing within the Region. In the Colorado Front Range, the Arapaho and Roosevelt National Forests removed 57,370 trees on 11,000 hectares (27,000 acres) in beetle suppression efforts during 1978. The Front Range Vegetative Management Pilot Project, a joint effort by public and private landowners designed to apply intensive forest practices to 13,800 hectares (34,000 acres) of beetle infested and susceptible lands, treated 79,746 infested trees during 1978.

The Black Hills National Forest removed 86,872 trees from 31,500 hectares (77,899 acres) during 1978. The Shoshone National Forest removed 7,427 trees from 200 hectares (500 acres) in beetle suppression efforts.

WESTERN BALSAM BARK BEETLE: *Dryocoetes confusus* Swaine.

Dryocoetes damage was more prevalent on the Colorado western slope. Infestations were identified on the Blanco Ranger District, White River National Forest. Activity was also observed on Naval oil shale lands near Rifle, Colorado and in the Grand Mesa National Forest.

DEFOLIATORS

WESTERN SPRUCE BUDWORM: *Choristoneura occidentalis* Freeman

The western spruce budworm (Fig. 1) remained a serious defoliator in Douglas-fir and white fir stands in Colorado and in Douglas-fir stands in Wyoming. The budworm reached epidemic levels in 1975 and has continued at these levels into 1978. Defoliation was extensive in Colorado in 1977 and 1978 with over 364,000 hectares (900,000 acres) of forest land exhibiting various levels of defoliation. Damage was most severe on the Arapaho and Roosevelt National Forests with some Douglas-fir stands supporting chronic budworm populations since the onset of the epidemic. Three separate centers of budworm activity were located in the San Juan National Forest. In Wyoming, the Clarks Fork District of the Shoshone National Forest also reported an outbreak of budworm.

Egg mass surveys indicate decreasing budworm populations in the San Isabel National Forest, while populations in the Pike National Forest were increasing. Western spruce budworm numbers in the Arapaho and Roosevelt National Forests were expected to increase slightly.

WESTERN TENT CATERPILLAR: *Malacosoma californicum* (Packard)

The western tent caterpillar (Fig. 2) defoliated an estimated 3,200 hectares (8,000 acres) of aspen in the Pagosa Springs Ranger District, San Juan National Forest during 1978. This outbreak was first reported in 1976 and caused extensive defoliation in 1977 and 1978. Lesser outbreaks occurred on the San Carlos Ranger District, Pike and San Isabel National Forests and in the vicinity of Pass Creek, west of Walsenberg, Colorado. Caterpillar parasitism in the Pass Creek outbreak was high in 1978.

PINE TORTRIX: *Choristoneura lambertiana ponderosana* Obraztsov.

The pine tortrix caused visible defoliation to ponderosa pine along the north fork of the South Platte River on the Pike National Forest. Populations of this insect increased greatly over 1977 levels.

PINE TIP MOTHS: *Rhyacionia bushnelli* (Busck), *R. frustrana* (Comstock), and *R. neomexicana* (Dyar)

In South Dakota, tip moths increased on shelterbelt pines, while in the Black Hills damage was widespread, but less obvious. *Rhyacionia frustrana* continued to be a problem in Kansas, where severe infestations were common in the south central section of the state. In southeast Kansas, loblolly pine was commonly infested but Austrian pine was rarely attacked.

ASPEN LEAFMINER: *Phyllocnistis populiella* Chambers

An aspen leafminer (Fig. 1) epidemic has been ongoing in the northern Black Hills for several years. In 1978, severe defoliation occurred in the northern Black Hills and leafminer populations were increasing in the southern Black Hills.

DOUGLAS-FIR TUSSOCK MOTH: *Orgyia pseudotsugata* (McDunnough)

Tussock moth activity in the Region was confined to urban areas along the Colorado Front Range. The insect has been a persistent

problem on ornamental spruce in Denver, and more recently in Colorado Springs and Boulder. Tussock moth damage to ornamental trees concerns many homeowners.

ELM LEAF BEETLE: *Pyrrhalta luteola* (Müller)

The elm leaf beetle caused extensive defoliation of American and Siberian elms in metropolitan Denver. Visible defoliation greatly increased over 1977. In South Dakota, leaf beetle populations on ornamental, shelterbelt, and native elms were high throughout the state. Severe defoliation was reported in the prairie and in urban areas of the Black Hills. In Kansas, leaf beetle damage was extensive, but generally less severe than in previous years.

MISCELLANEOUS INSECT PROBLEMS

COLORADO: The spruce beetle, *Dendroctonus rufipennis* (Kirby), was endemic throughout the Region. Shoot- and cone-mining moths, *Dioryctria* sp. believed in the *albovitella* complex, damaged pinyon pine in Larimer County (Fig. 2). This species was also reported in the Colorado Springs and Walsenberg areas. Pine needle miner, *Coleotechnites* sp., damage to ponderosa pine was more apparent than in previous years from Palmer Lake to Fort Collins along the Front Range. White fir needle miner, *Epinotia meritana* Heinrick, continued to defoliate white fir in the Pass Creek area (Huerfano County). The infestation was first detected in 1972 and tree mortality became increasingly evident in 1978. A flocculent fir aphid, *Cinara occidentalis* (Davidson), outbreak in western Colorado (Garfield County) has apparently subsided. The twig beetle *Pityophthorus opaculus* LeConte was discovered in the new growth of subalpine fir in Garfield County. This is a new host record for *P. opaculus*.

NEBRASKA: Damage to green ash by the redheaded ash borer, *Neoclytus acuminatus* (F.), was reported in Douglas, Nemaha, Lancaster, and Pawnee Counties. Severe infestations of the fall cankerworm, *Alsophila pometaria* (Harris), on hackberry and honeylocust occurred in Hall and Antelope Counties. The Zimmerman pine moth, *Dioryctria zimmermani* (Grote), was recorded for the first time in Garden, Wayne, and Pierce Counties. Ash plant bugs, *Tripodosteptes amoenus* Reuter, caused severe leaf damage to ash

in isolated windbreaks in Saunders and Lancaster Counties. An undescribed gall-forming insect causing twig dieback was discovered on black walnut. Surveys conducted in 1978 on black walnut plantations indicated this pest occurred in 19 of the 24 counties surveyed. The larch sawfly, *Pristiphora erichsonii* (Hartig) (Fig. 1), was reported in Cass County.

KANSAS: Unusually high numbers of green-striped mapleworms, *Anisota rubicunda* (F.), defoliated maple in the northeast area of the state. Bagworms, *Thyridopteryx ephemeraeformis* (Haworth), caused some tree mortality in isolated infestations. Grasshoppers, *Melanoplus* spp., damaged numerous species of young shelterbelt trees. Honeylocust was defoliated by the Mimosa webworm, *Homadaula anisocentra* Meyrick, in eastern Kansas. The bronze birch borer, *Agrius anxius* Cory, caused widespread damage to ornamental birch in Kansas City, Lawrence, and Topeka. Leafhoppers, *Macropsis fumipennis* G. & B., and plant bugs, *Diaphnocoris* sp. caused serious defoliation and twig dieback to honeylocust in some southern counties.

SOUTH DAKOTA: The pitch nodule moth, *Petrova metallica* (Busck), infestation in ponderosa pine at the Big Sioux Conifer Nursery in Watertown, collapsed in late 1977 or early 1978. Unusually high precipitation was the suspected cause. Elsewhere, the sumac sawfly, *Agre coccinea* (F.), caused severe defoliation and some mortality to sumac in Yankton County. The cottonwood leaf beetle, *Chrysomela scripta* (F.), severely defoliated aspen regeneration in localized areas in the northern Black Hills. Moderate to heavy defoliation by the same insect was reported on cottonwood in Custer and Pierre Counties along the Missouri River. The ash sawfly, *Tomostethus multicoloratus* (Rohwer) or *Tethida cordigera* (Beauvois), caused locally severe defoliation to ash in Minnehaha, Lincoln, and Brown Counties. Wood borers (Coleoptera: Buprestidae and Cerambycidae) damaged crown scorched trees in prescribed burns in the Black Hills. Trees with 75 percent or greater crown scorch were attacked in several geographical areas. Wood borers also damaged construction-weakened trees in housing subdivisions. Flat-headed wood borers damaged black locust trees in the southeastern portion of the state. The red turpentine beetle, *Dendroctonus valens* LeConte, was also reported in fire-damaged, construction-weakened, and other disturbed trees in the Black Hills. This beetle was also found attacking apparently undisturbed young ponderosa pine plantations in the Black Hills.

STATUS OF DISEASES

DWARF MISTLETOES

LOGGEPOLE PINE DWARF MISTLETOE: *Arceuthobium americanum* (Nutt. ex Engelm.)

This mistletoe continued as one of the most important disease problems in lodgepole pine stands in the Rocky Mountain Region. An estimated 50 percent of the commercial lodgepole pine forest in the Region was infested with the parasite. Estimates of annual loss to *A. americanum* in Region 2 for lodgepole pine are presented in Table 1.

Surveys of incidence and infection levels of lodgepole pine dwarf mistletoe were conducted in the Red Feather Ranger District, Roosevelt National Forest from 1973-77. Dwarf mistletoe was recorded on 83.8 percent of 7300 plots within 18,225 hectares (45,000 acres) of the lodgepole pine type. Over 53 percent of the plots had an average dwarf mistletoe rating of 3 or greater. Data were input into the RMYLD Program ^{1/} to determine growth loss and mortality associated with dwarf mistletoe infection. The Program projected an average yearly loss of 15.2 cubic feet per acre (5.0 cubic feet for pole-size stands; 27.0 cubic feet for sawtimber-size stands).

Presuppression surveys for lodgepole pine dwarf mistletoe were conducted on 3,600 hectares (9,000 acres) on National Forests in Wyoming. Infected overstory removal was conducted on 106 hectares (262 acres) within the Shoshone National Forest.

Additional survey and control projects involving lodgepole pine dwarf mistletoe are planned on National Forests of Colorado. Control operations will emphasize removal of infested overstory, sanitation adjacent to clearcuts, and replacement of heavily infested stands. The Bureau of Land Management will conduct pre-suppression surveys on almost 6,900 hectares (17,000 acres) of lands in Colorado.

^{1/}

Edminster, C. B. 1978. RMYLD: Computation of yield tables for even-aged and 2-aged stands. USDA, For. Serv., Rocky Mt. For. and Range Exp. Sta. Res. Pap. RM-199, 26 pp.

Table 1. Estimate of annual cubic foot volume loss of lodgepole pine to *Arceuthobium americanum* for National Forests in R-2.

National Forest and Date of TM Plan	Thousands of hectares (acres) of type ^{1/}			Annual cubic foot volume loss		
	Poles	Sawtimber	Total	Poles	Sawtimber	Total
Arapaho and Roosevelt (1975-76)	79.6 (196.7)	106.0 (261.7)	185.6 (458.4)	983,500	7,065,900	8,049,400
Bighorn ^{2/} (1975)	45.6 (112.7)	55.0 (135.8)	100.6 (248.5)	180,320	529,620	709,940
Grand Mesa-Uncompahgre, and Gunnison (1975)	23.8 (58.9)	35.9 (88.7)	59.8 (47.6)	294,500	2,394,900	2,689,400
Medicine Bow ^{2/} (1975)	38.3 (94.6)	85.2 (210.4)	123.5 (305.0)	586,520	3,366,400	3,952,920
Pike and San Isabel (1962)	48.6 (120.0)	23.1 (57.0)	71.7 (177.0)	600,000	1,539,000	2,139,000
Rio Grande (1978)	0 (0)	2.5 (6.3)	2.5 (6.3)	0	170,100	170,000
Routt (1975)	20.4 (50.3)	49.7 (122.8)	70.1 (173.1)	251,500	3,315,600	3,567,100
Shoshone ^{2/} (1976)	28.6 (70.7)	26.2 (64.6)	54.8 (135.3)	410,060	374,680	784,740
White River (1962)	28.7 (71.0)	30.8 (76.0)	59.5 (147.0)	355,000	2,052,000	2,407,000
Totals	313.8 (774.9)	414.4 (1,023.3)	728.3 (1,798.2)	3,661,400	20,808,000	24,469,600

^{1/} Includes only acres of pole- and sawtimber-size trees 12.7 cm (5.0 inches) d.b.h. and larger on commercial National Forest lands.
Data source - Timber Management Plans.

^{2/} Estimate from 1977-78 surveys conducted by FI&DM and RMFRES personnel.

SOUTHWESTERN DWARF MISTLETOE: *Arceuthobium vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. and Wiens

Southwestern dwarf mistletoe continued to be an important disease of ponderosa pine in the Front Range of Colorado. An estimated 46 percent of the ponderosa pine in the Front Range was infested with this parasite. Estimates of annual loss to *A. vaginatum* subsp. *cryptopodum* in Region 2 for ponderosa pine are presented in Table 2.

LIMBER PINE DWARF MISTLETOE: *Arceuthobium cyanocarpum*
Coulter and Nelson

Limber pine dwarf mistletoe was found for the first time on whitebark pine near South Pass, Shoshone National Forest. The parasite was common and damaged both limber pine and whitebark pine.

STEM DISEASES

COMANDRA BLISTER RUST: *Cronartium comandrae* Peck.

This rust continued to pose problems to management of lodgepole pine within the Bighorn, Medicine Bow, and Shoshone National Forests. Damage consisted primarily of spiked tops, growth reduction, and mortality in pole- to sawtimber-size trees. Estimated acreages of commercial forest infested with rust ranged from 32-37 thousand hectares (80-90 thousand acres) in each of the three forests.

JACK PINE DECLINE

An unexplained decline of plantation jack pine (Fig. 3) occurred within the Nebraska National Forest. Symptoms found on groups of trees included chlorotic foliage and reduced needle retention and length. These symptoms usually were not evenly distributed throughout the crown (Fig. 3). Blue stain fungi (primarily *Ceratocystis minor* (Hedge.) Hunt) and numerous insects (*Ips*

Table 2. Estimate of annual cubic foot volume loss of ponderosa pine to *Arceuthobium vaginatum* subsp. *cryptopodum* for National Forests in R-2.

National Forest and Date of TM Plan	Thousands of hectares (acres) of type ^{1/}			Annual cubic foot volume loss		
	Poles	Sawtimber	Total	Poles	Sawtimber	Total
Arapaho and Roosevelt (1975-76)	6.1 (15.0)	41.6 (102.8)	47.7 (117.8)	180,000	1,233,600	1,413,600
Grand Mesa-Uncompahgre and Gunnison (1975)	2.8 (7.0)	28.3 (70.0)	31.2 (77.0)	84,000	840,000	924,000
Pike and San Isabel (1962)	17.0 (42.0)	119.5 (295.0)	136.5 (337.0)	504,000	3,540,000	4,044,000
San Juan (1976)	0 (0)	77.3 (191.0)	77.3 (191.0)	0	2,292,000	2,292,000
Totals	25.9 (64.0)	266.8 (658.8)	292.7 (722.8)	768,000	7,905,600	8,673,600

^{1/} Includes only acres of pole- and sawtimber-size trees 12.7 cm (5.0 inches) d.b.h. and larger on commercial National Forest lands. Data source - Timber Management Plans.

calligraphus (Germar), *Dendroctonus valens* Lec., *Hylurgops porosus* Lec., *Othius* spp., *Corticelus* spp., and cerambycid wood borers) were associated with the damage. Unknown site factors probably predisposed trees to attack by these fungi and insects. About 16 percent of plantation jack pine trees within the Nebraska National Forest were either dead or displayed symptoms of this malady.

ASH HEARTROT: *Fomes fraxinophilus* (Peck) Sacc.

This fungus (Distribution Map, Fig. 4), a major cause of heartrot in green ash, was widely distributed throughout shelterbelts established during 1935-1942 by the Nebraska Prairie State Forestry Project. A total of 55,147 living green ash trees in 173 shelterbelts in 41 Nebraska counties were examined from November 1977 to May 1978. Based on occurrence of sporocarps, infected trees were found in 40 counties and in 90 percent of the shelterbelts examined. The fungus was present in all shelterbelts examined in eastern counties with a mean incidence of 6.5 percent on examined trees; in 96 percent of shelterbelts in central counties with a mean incidence of 5.4 percent; and in 21 percent of shelterbelts examined in western counties with an incidence of 0.2 percent. Overall statewide incidence in examined trees was 5.5 percent. This fungus was causing significant deterioration of green ash in shelterbelts, especially in eastern Nebraska.

WESTERN GALL RUST: *Endocronartium harknessii*
(J. P. Moore) Y. Hirat.

Western gall rust (Fig. 5) was an important disease of ponderosa pine in the Black Hills of South Dakota and the Nebraska National Forest. High infection levels were common within many plantations and young natural stands. There was great variability in individual tree susceptibility to rust infection. Discrimination against heavily infected trees during stand entries was recommended.

CYTOSPORA CANKER: *Cytospora chrysosperma* (Pers.) F.

Cytospora canker (Fig. 6) was common on numerous hardwoods throughout the Region. It was especially important on aspen in the Rocky Mountains and eastern cottonwood in the Great Plains. Evaluations in cottonwood energy plantations in eastern Kansas

indicated that *C. chrysosperma* was important in dieback of 2- and 3-year-old trees. Variation of clones to infection was noted.

SIBERIAN ELM CANKER: *Botryodiplodia hypoderma* Sacc.

This canker disease was widespread on Siberian elm in shelterbelts and ornamental plantings in South Dakota, Nebraska, and Kansas. Canker induced mortality was more common in the western portions of these states.

PORCUPINE DAMAGE

Extensive basal girdling and subsequent mortality in 35-year-old lodgepole pine plantations near Molas Pass on the San Juan National Forest was noted. Porcupine activity occurred over the past few years and mortality was extensive enough to reduce stocking within certain portions of these plantations.

SAPSUCKER DAMAGE

Damage to pines by sapsuckers was common throughout the Great Plains. Evaluations in Kansas indicated that sapsucker damage to pines was present in all but one of 68 counties surveyed. Damage was more common on Austrian and Scots pine than on ponderosa pine. Also, older and less healthy appearing trees were damaged more. Little mortality resulted from sapsucker damage.

VASCULAR WILTS

DUTCH ELM DISEASE: *Ceratocystis ulmi* (Buism) C. Mor.

Dutch elm disease continued to cause loss of American elms throughout the Region. The disease spread into the western portion of South Dakota where it was reported in a new county (Pennington). Approximately 100-200 new cases were reported in Rapid City, South Dakota.

Dutch elm disease increased within many cities of western Kansas. An upward trend in losses in certain parts of the state were reported.

Colorado was a participant in the Federal Dutch Elm Disease Control Demonstration Project. Several control programs were carried out in four eastern Colorado communities (Canon City, La Junta, Yuma and Eaton). Programs included surveys (tree mapping, broodwood surveys, symptom surveys, and tree removal), spraying methoxychlor, deadwood pruning, trenching, information and education, utilization, and technical information retrieval. During 1978 in the four project communities, 296 confirmed cases of Dutch elm disease, which represents 0.6 percent of the large leaf elm population, were reported. This Project will continue in 1979.

OAK WILT: *Ceratocystis fagacearum* (Bretz) Hunt.

No new reports of oak wilt were received during the past year. The disease was endemic in portions of eastern Nebraska and Kansas and occurred in southeastern South Dakota.

ROOT DISEASES

ANNOSUS ROOT DISEASE: *Fomes annosus* (Fr.) Cke.

Mortality associated with root- and butt-rot of white fir caused by *F. annosus* (Distribution Map, Fig. 7) was found for the first time in Colorado. Typical infection centers containing dead and dying trees were found within white fir stands in three National Forests in southern Colorado (San Isabel, Rio Grande, and San Juan). *Fomes annosus* sporophores were common within stumps and remnants of over-mature dead white fir trees. White to yellow stringy root decay was associated with the disease. Observations of numerous wind-thrown trees within infection centers indicated that decay usually proceeds up through the root systems to the butt portion of trees. Infection centers were not always located within cutover stands, however, mortality was more pronounced in such areas. The disease was causing little damage in most areas, however, within some areas many young trees were killed. The importance of this disease may increase as management of white fir intensifies.

SHOESTRING ROOT ROT: *Armillariella mellea* (Fr.) Karst.

Shoestring root rot was common on many different hosts throughout the Rocky Mountain Region. Surveys in young (less than 25 years old) lodgepole pine stands indicated variable incidence of the pathogen. Within the Routt, Grand Mesa-Gunnison and Uncompahgre, and White River National Forests of Colorado, 1.7 to 11.2 percent of the trees surveyed in reproduction on cutover sites were infected. Mortality due to the pathogen occurred in groups and was most common adjacent to stumps.

Armillariella mellea was also associated with western balsam bark beetle (*Dryocoetes confusus*) attack of subalpine fir in the White River National Forest. In several locations, all sampled trees with bark beetle attacks were infected with *A. mellea*. Patterns of mortality indicated probable infection by the fungus followed by bark beetle attack.

BLACK STAIN ROOT DISEASE: *Verticicladiella wagnerii* Kendrick.

This disease was found on pinyon, west of the Continental Divide in Colorado. Evaluation of *V. wagnerii* in Mesa Verde National Park, Colorado revealed at least 175 active disease centers within 21,000 hectares (52,000 acres) of the Park. Many old centers were also present. Disease centers apparently stabilize after a few years with a resultant slowdown of mortality. However, high rates of new infection center establishment guarantee continued significant losses. Insects may be involved as vectors of the fungus and play an important role in establishment of new centers.

No other hosts of this fungus have been found in the Rocky Mountain Region. Investigations in California and Oregon showed that the fungus infects other hosts such as ponderosa pine and Douglas-fir. It is not known why this fungus does not occur on these hosts in the Rockies or on pinyon pine east of the Continental Divide.

FOLIAGE DISEASES

SPRUCE AND FIR BROOM RUSTS: *Chrysomyxa arctostaphyli* Diet. and
Melampsorella caryophyllacearum Schroet.

Broom rust (Fig. 8) of Engelmann spruce (*Chrysomyxa arctostaphyli*) and subalpine fir - white fir (*Melampsorella caryophyllacearum*) was commonly found in spruce-fir stands throughout the Rocky Mountain Region. Surveys were conducted to determine incidence and evaluate damage in selected stands on five national forests in Colorado (Grand Mesa-Uncompahgre and Gunnison, Rio Grande, San Juan, Arapaho and Roosevelt, and White River). The highest incidence of spruce broom rust occurred on the Rio Grande National Forest where up to 45 percent of sawtimber trees surveyed were infested. Fir broom rust was most common in the San Juan National Forest. In this Forest, as many as 80 percent of the sawtimber trees surveyed were infested. Distribution and incidence of broom rust was widespread and highly variable within surveyed stands. Whereas damage due to the disease was common in some stands, it was negligible in others. Tree mortality was often associated with infections on or near boles of trees. Heavily infected trees were often attacked and subsequently killed by bark beetles. In heavily-infested stands, diseased trees should be removed during stand entries.

RED BAND NEEDLE BLIGHT: *Dothistroma pini* Hulb.

Dothistroma pini was widespread throughout ornamental plantings in eastern Nebraska and Kansas. Within Kansas and most of Nebraska, the disease was at relatively low levels. However, in Christmas tree plantations in Nemaha and Holt counties (Nebraska) the disease caused serious damage.

DIPLODIA TIP BLIGHT: *Diplodia pinea* (Desm.) Kickx.

Incidence of this pathogen was high and damage severe in several plantings of Austrian pine over 30-years-old in eastern Nebraska. Damage also increased significantly throughout the eastern half of Kansas (Distribution Map). A survey for tip blight in Kansas revealed that trees with heavily infected cones were common in areas where little or no infected shoots existed. Although damage was most common on older Austrian pine, young Austrian pine, Scots pine and ponderosa pine were also infected.

SPRUCE NEEDLECAST: *Rhizosphaera kalkhoffii* Bub.

This needle fungus was found in native Engelmann spruce stands on the Fraser Experimental Forest, Colorado for the first time. The pathogen was associated with brooms of apparent genetic origin and caused little damage.

LIMBER PINE NEEDLECAST: *Lophodermella arcuata* (Danker) Daner.
Lophodermium (*Leptostrota*) spp.

These needlecast fungi were found on scattered, pole- and sawtimber-size limber pine on the Shoshone National Forest. *Lophodermella arcuata* was on current year's foliage; whereas, *Lophodermium* spp. were attacking older, senescent needles.

WALNUT ANTHRACNOSE: *Gnomonia leptostyla* (Fr.) Les. & deNot.

This disease was widespread throughout Nebraska in 23 of 24 recently surveyed counties (Distribution Map). However, the disease was only serious in plantations in one county and not economically damaging in the other counties.

Gnomonia leptostyla was also common in portions of Moody, Minnehaha, Lincoln, and Turner counties of South Dakota.

COTTONWOOD LEAF RUST: *Melampsora medusae* Thum.

Leaf rust was common on eastern cottonwood located within plantations and windbreaks throughout Nebraska and Kansas. Higher incidence of this rust was recently observed on several cottonwood clones in experimental plots near Lincoln, Nebraska. The disease usually caused little damage other than premature leaf abscission.

ABIOTIC DISEASES

HERBICIDE DAMAGE

Tree damage from herbicide application was widespread throughout the Great Plains, especially in trees near cultivated fields. Especially heavy losses occurred to eastern redcedar in portions of central and eastern Kansas. Indiscriminate and non-regulated application of herbicides often caused significant direct damage as well as predisposing trees to attack by pathogens and insects.

WINTER DAMAGE

Winter damage was unusually common on cedars, redbuds and pines in portions of western Kansas. Damage was so extensive in certain areas as to result in dieback of redbud.

AIR POLLUTION DAMAGE

Foliar symptoms on some ponderosa pine near Denver, Colorado resembled oxidant air pollution damage. Symptoms included reduced needle retention and length and needle chlorosis. Air pollution levels were high enough within metropolitan Denver to elicit responses by plants, however, levels in outlying areas with large pine populations were unknown. Plans were made for continued examination of pine for air pollution damage.

DISEASES OF UNKNOWN ETIOLOGY

ASPEN DROOP

This widespread and damaging disorder of aspen, characterized by elongated, drooping branches, and lack of lateral twigs, was noticed for the past few years in the Colorado Rockies. Death of affected trees occurred in time. Causes of the disease are unknown and currently under investigation at Colorado State University.

HARDWOOD DECLINES

Declines of hardwoods such as hackberry, maple and oak were common in many parts of the Great Plains. Investigations of the etiology of these declines failed to reveal any consistent role of pathogenic organisms and environmental stresses.

NURSERY DISEASES

DIPLODIA TIP BLIGHT: *Diplodia pinea* (Desm.) Kickx.

Diplodia caused scattered mortality in beds of 2-0 Austrian pine at Bessey Nursery in Nebraska. Ponderosa pine with heavily infected cones adjacent to nursery beds probably provided sources of inoculum. This disease was controlled by roguing infected seedlings.

SHOT HOLE DISEASE: *Coccoomyces lutescens* Higg.

This disease recently caused severe defoliation of chokecherry seedlings at Bessey Nursery, Nebraska. However, the disease was subsequently controlled with fungicide applications.

GREY MOLD: *Botrytis cinerea* (Fr.)

Grey mold of containerized conifer seedlings within greenhouses continued to cause problems. Laboratory screening of fungal isolates from three Colorado nurseries revealed high levels of tolerance to a number of commercial fungicides, especially benomyl. However, most isolates were at least susceptible to some of the fungicides tested so that recommendations for alternative chemical schedules to control this disease could be made. Adequate spacing and aeration among seedlings was important in reducing losses from *B. cinerea*.

DAMPING-OFF: *Fusarium* spp. and *Pythium* spp.

Losses to 1-0 ponderosa pine seedlings were reduced at Mt. Sopris Nursery (Carbondale, Colorado) by fumigation with 500 lb/acre of Dowfume[®] MC-33. Survival was four times greater in fumigated beds than in non-fumigated beds.

D I S E A S E S O F M I N O R I M P O R T A N C E

CAUSAL AGENT	HOSTS	LOCATIONS	REMARKS
<i>Alternaria</i> spp.	Silver maple	Bessey Nursery, Nebraska	
Bacteria	Cottonwood	Loveland, Colorado	Mortality of cottonwood attributed to bacterial wetwood.
<i>Botryosphaeria</i> spp.	Redbud	Kansas	
<i>Cercospora sequoiae</i> (E. & E.)	Eastern redcedar	Kansas	
<i>Crytosphaeria</i> (<i>Libertella</i>) spp.	Eastern cottonwood	Bessey Division, Nebraska National Forest	Common on trees near the nursery; symptoms may be confused with those caused by <i>Cytospora chrysosperma</i>
<i>Dothiora polyspora</i> Shear & David.	Aspen	Colorado	Associated with wounds on aspen sprouts
<i>Dothiorella</i> spp.	Elm, oak	Kansas	
<i>Erwinia amylovora</i> (Burr.) Winol.	Walnut, apple, pear, cherry	Kansas, Nebraska	
<i>Fusarium</i> spp.	Eastern redcedar	Kansas	
<i>Gnomonia platani</i> Edg.	Sycamore	Eastern Kansas	Especially damaging on twigs and major branches during May and June.
<i>Gnomonia quercina</i> Kleb.	Oak	Lancaster, Douglas, & Lincoln Counties, Nebraska	
<i>Gnomonia ulmea</i> (Schw. ex Fr.) Thuem.	Elm	Kansas	
<i>Gymnosporangium juniperi - virginianae</i> Schw.	Utah juniper, eastern redcedar	Colorado, Nebraska, Kansas	
<i>Marssonina populi</i> (Lib.) Magn.	Aspen, eastern cottonwood	Colorado, Kansas	
<i>Mycosphaerella</i> spp.	Ash	Kansas	
<i>Phoma</i> spp.	Lodgepole pine	Bessey Nursery, Nebraska	Associated with chlorosis and mortality of 1-0 seedlings
<i>Phomopsis juniperovora</i> Hahn.	Eastern redcedar	Kansas	
<i>Phyllosticta</i> spp.	Silver maple	Bessey Nursery, Nebraska	
<i>Physalospora miyabeana</i> Fuku.	Eastern cottonwood, willow	Kansas	
<i>Phytophthora cactorum</i> (Leb. & Cohn)	Russian olive	Ft. Collins, Colorado	
<i>Puccinia peridermiospora</i> (Ell. & Tr.)	Ash	Saunders & Valley Counties, Nebraska	
<i>Septoria musiva</i> Pk.	Eastern cottonwood	Nebraska, Kansas	
<i>Taphrina caerulea</i> (Mont. & Desm) Tul.	Oak, elm	Lancaster County, Nebraska Eastern Kansas	High levels of infection were found throughout many parts of eastern Kansas due to persistent overcast weather conditions and high inoculum levels.
<i>Venturia populina</i> (Vuill.)	Eastern cottonwood, willow	Kansas	
<i>Verticillium albo-atrum</i> (Reinke & Berth)	Maple	Wayne County, Nebraska	

FI&DM WORKSHOPS

During the past year the Forest Insect and Disease Management Staff offered classroom and field training in the recognition and suppression of major forest insect and disease pests in the Region. Training consisted of two-day workshops held on the Routt, San Juan, Rio Grande, and Bighorn National Forests. In addition to Forest personnel, other Federal and State forest management agency personnel also attended.

The workshops are available upon request by federal agencies for which FI&DM has responsibility for insect and disease detection and evaluation. State forestry personnel are also welcome to attend these sessions.

Four training sessions are planned each year. They are scheduled in late spring and late fall to avoid conflict with normal field activities.

FIGURE 1

- A. Aspen (*Populus tremuloides*) leaf mined by the aspen leafminer, *Phyllocnistis populiella*.
- B. A mature larva of the western spruce budworm, *Choristoneura occidentalis*, on one of its preferred hosts, white fir (*Abies concolor*).
- C. Larch sawfly, *Pristiphora erichsonii* in Cass County, Nebraska.

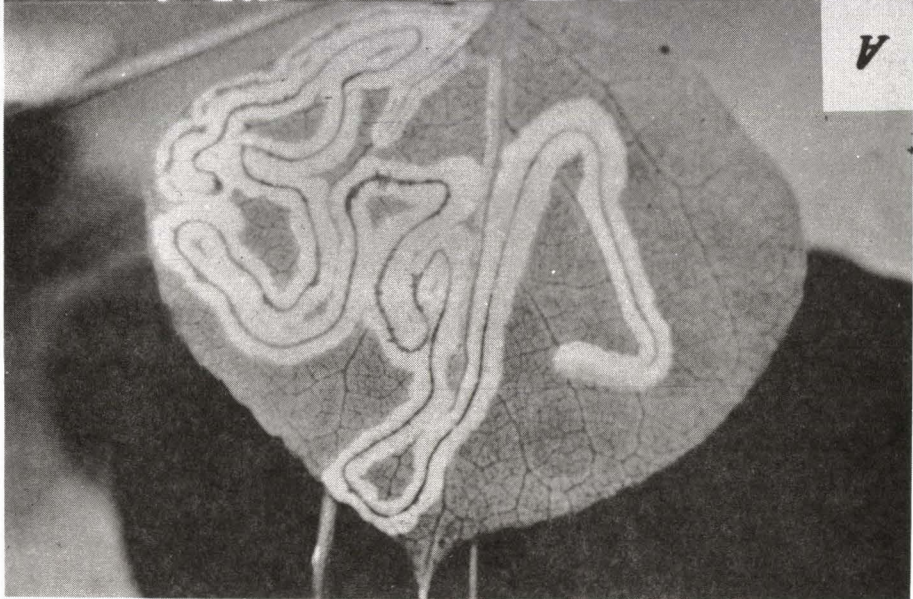
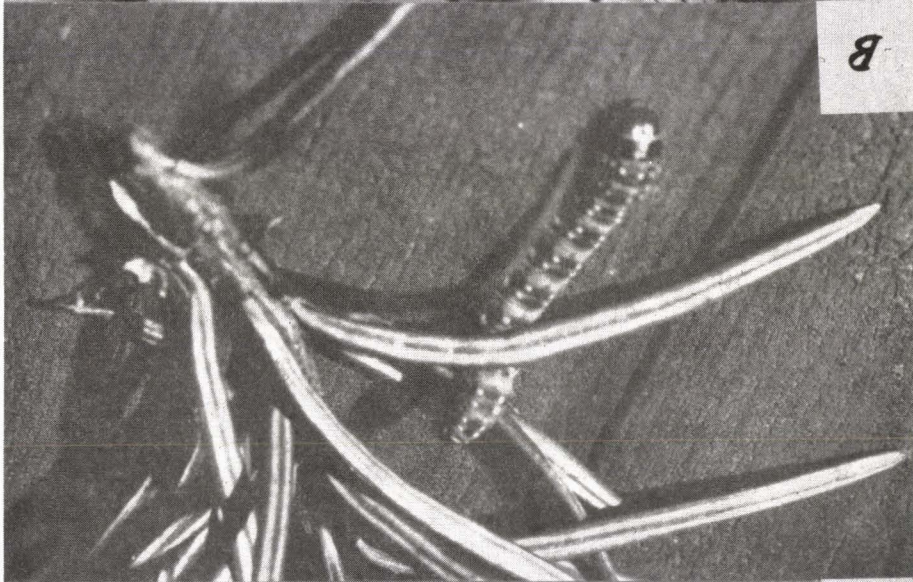


FIGURE 2

- A. Mature larvae of the western tent caterpillar, *Malacosoma californicum*. These insects were abundant in southern Colorado in 1978.
- B. An adult shoot- and cone-mining moth, *Dioryctria* sp., damaging pinyon, *Pinus edulis*, in Larimer County, (Colorado) (Photographed by L. Merrill, Colorado State University).



FIGURE 3

JACK PINE DECLINE

- A. Symptom pattern on declining trees. Foliage is sparse and chlorotic on affected trees; trees along the edges of stands appear more susceptible to damage.
- B. Black stain beneath the bark of declining jack pine is caused primarily by fungi (*Ceratocystis* spp.) which are carried to trees by insects.
- C. Resin-soaked discoloration at the base of declining jack pine. Resin was commonly produced in streaks.
- D. Red turpentine beetle (*Dendroctonus valens*) attack (arrow) at the base of declining jack pine.

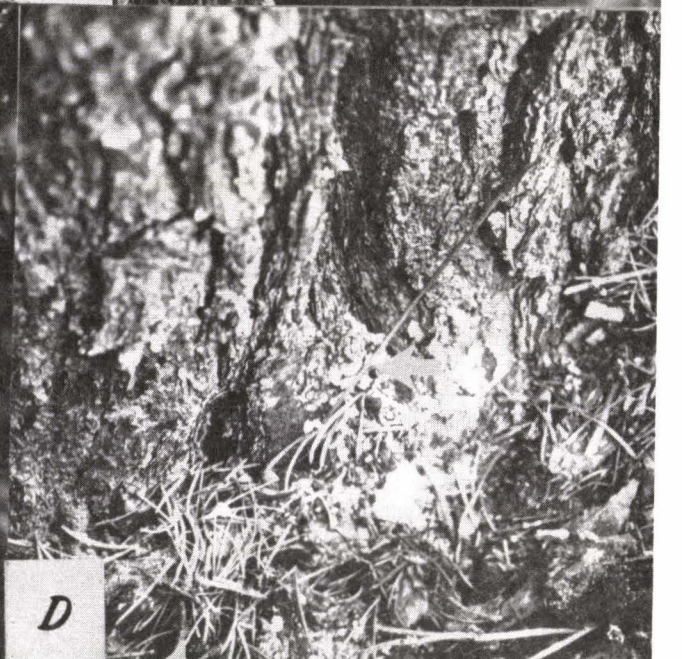
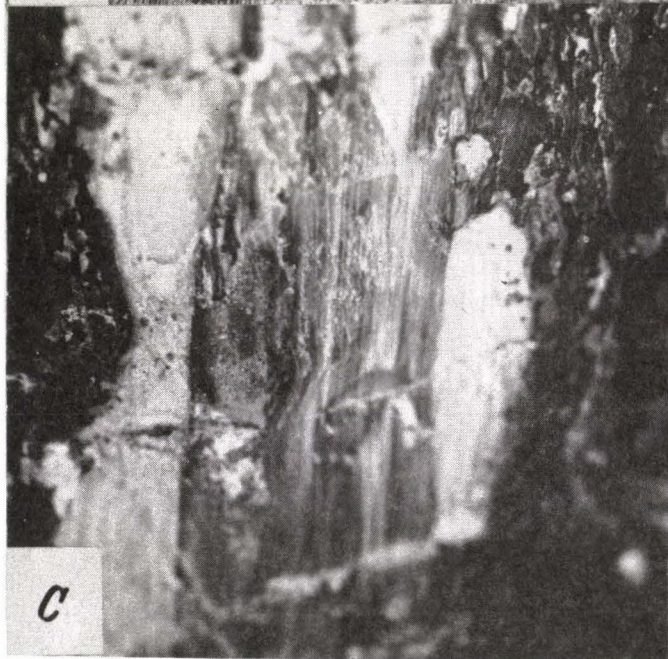


FIGURE 4

ASH HEARTROT

- A. Typical Prairie States Forestry Project shelterbelt in Nebraska. Green ash was one of the most commonly planted species in these shelterbelts.
- B. *Fomes fraxinophilus* sporophores on green ash. Many sporophores are produced at sites of old branches.
- C. Closeup of *Fomes fraxinophilus* sporophore on the bole of green ash.



FIGURE 5

WESTERN GALL RUST

- A. Galls produced by infection by *Endocronartium harknessii* on ponderosa pine.
- B. "Hip canker" - remnant of old stem infection by *Endocronartium harknessii* on lodgepole pine.
- C. Closeup of branch gall on ponderosa pine. Rust aeciospores are produced on galls; these spores reinfect pine.

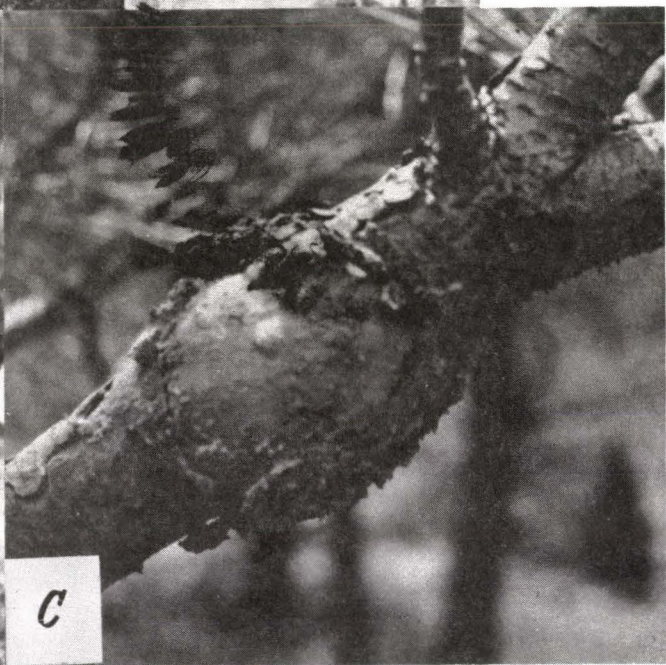


FIGURE 6

CYTOSPORA CANKER OF COTTONWOOD

- A. Cottonwood plantation in Kansas. These trees are grown on short rotations to provide fuel for energy production.
- B. Cottonwood branch infected with *Cytospora chrysosperma*. Erumpent pycnidia (arrow) break through the bark and release spores during rainfall.
- C. "Blackstem" canker on cottonwood caused by *Cytospora chrysosperma*.



FIGURE 7

FOMES ANNOSUS ON WHITE FIR

- A. White fir mortality caused by *Fomes annosus*. Infected trees die in groups -- forming centers.
- B. Old-growth white fir remnant infected with *Fomes annosus* and adjacent killed tree. The fungus spreads from tree to tree via root contacts and grafts.
- C. *Fomes annosus* sporophore on an infected white fir root. Fungal spores are produced within the pores of the sporophore.
- D. *Fomes annosus* sporophore (arrow) at the base of infected white fir. Sporophores are attached to the bole below the surface litter.

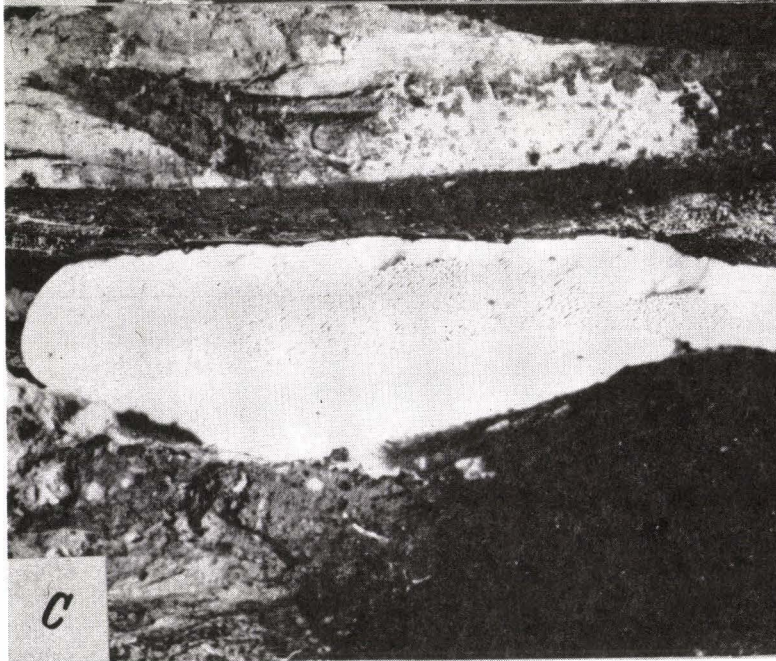


FIGURE 8

SPRUCE-FIR BROOM RUST

- A. Spruce broom rust (*Chrysomyxa arctostaphyli*) on Engelmann spruce. Brooms (arrow) near the bole of trees may provide sites for entrance by decay fungi.
- B. Sporulation (aeciospores) of fir broom rust (*Melampsorella caryophyllacearum*) on true fir. These spores infect the alternate host (chickweed).
- C. Fir broom rust on white fir. The rust fungus causes alterations in foliage size and distribution.



USDA FOREST SERVICE DETECTION REPORT

FOREST INSECT AND DISEASE DAMAGE

Form 5200-1

To encourage forest pest reporting for the Rocky Mountain Region, we invite all interested agencies to complete Form 5200-1. Instructions for completing the report are found at the top of the page on each form.

Copies of 5200-1 are available upon request from the Forest Service, State and Private Forestry, Forest Insect and Disease Management, 11177 West 8th Avenue, Post Office Box 25127, Lakewood, Colorado 80225, Phone (303) 234-4877.

Whenever possible, insect or disease specimens or damage samples should be submitted with the report. Resource managers of Federal forest lands should submit specimens for identification to the Forest Insect and Disease Management Staff at the above address. Managers of non-Federal forest lands in Colorado, Kansas, Nebraska, South Dakota, and Wyoming should send detection reports and specimens to their respective state forestry organizations. A complete listing follows:

STATE FORESTRY ORGANIZATIONS

Colorado State Forest Service
State Forester-Thomas B. Borden
Colorado State University
Fort Collins, Colorado 80523
Telephone: (303) 482-8185,
491-6304/6305

Kansas State and Extension Forestry
State and Extension Forester -
Harold G. Gallaher
Forestry Building, 2610 Claflin Road
Manhattan, Kansas 66502
Telephone: (913) 532-5752

Nebraska State and Extension Forestry
Chairman, Department of Forestry and
State Forester-Dr. Mitchell D. Ferrill
201 Miller Hall, University of Nebraska
Lincoln, Nebraska 68583
Telephone: (402) 472-2944

Department of Wildlife, Parks,
and Forestry
Director of Forestry -
James D. Verville
Sigurd Anderson Building
Pierre, South Dakota 57501
Telephone: (605) 773-3623

Wyoming State Forestry Division
State Forester-Carl E. Johnson
1100 West 22nd Street
Cheyenne, Wyoming 82002
Telephone: (307) 328-9586

U.S. DEPARTMENT OF AGRICULTURE Forest Service		DETECTION REPORT FOREST INSECT AND DISEASE DAMAGE	
PART A - INSTRUCTIONS: <i>This report is authorized by the Forest Pest Control Act of 1947. Voluntary responses to the report greatly assist the Forest Service in the detection and prevention of potentially destructive insects and diseases. PRINT. Shaded areas to be completed by FS. Further instructions above.</i>			
1. TYPE OF LANDOWNERSHIP (X Appropriate Box) ☐ Federal _____ ☐ State _____ ☐ Private _____ National Forest and District State Forest and District			
2. LOCATION OF PROPERTY (Give drainage name, prominent landmark, mileage from known location, etc.)			
3. IDENTIFICATION OF PROPERTY (To be completed by FS) Township Range Section 1/4 Section 			
4. NAME AND BUSINESS ADDRESS (Include Zip Code) STATE COUNTY 		5. PHONE NUMBER (Include Area Code) 	
		6. DATE 	
7. ACTION REQUESTED (X Appropriate Box) ☐ None ☐ Identification ☐ Field Evaluation		8. SAMPLE OF DISLASE (X Appropriate Box) <i>For the instructions on back.</i> ☐ YES ☐ NO	
		9. MAP OF AREA ENCLOSED (X Appropriate Box) ☐ Yes ☐ No	
10. NUMBER OF ACRES DAMAGED		11. DISTRIBUTION OF DAMAGE WITHIN THE STAND (X Appropriate Box) ☐ Scattered ☐ Grouped	
12. SPECIES AFFECTED (Do not mark in boxes) 			
13. TREE SIZE (X Appropriate Box) ☐ - [20] Seedling ☐ - [21] Sapling ☐ - [22] Pole ☐ - [23] Sawtimber ☐ - [24] Overmature		14. PART(S) OF TREES DAMAGED (X Appropriate Box) ☐ - [30] Root ☐ - [31] Bole ☐ - [32] Branch ☐ - [33] Twig ☐ - [34] Leader ☐ - [35] New Foliage ☐ - [36] Old Foliage ☐ - [37] Bud ☐ - [38] Cone/Seed ☐ - [39] Wood	
15. STAND TYPE (X Appropriate Box) ☐ - [40] Nursery ☐ - [41] Plantation ☐ - [42] Natural ☐ - [43] Shelterbelt ☐ - [44] Ornamental ☐ - [45] Seed Orchards			
16. CASUAL AGENTS OR ASSOCIATED DISTURBANCE (X Appropriate Box) Insects ☐ - [50] Bark Beetle ☐ - [51] Defoliator ☐ - [52] Sapsucking ☐ - [53] Borer ☐ - [54] Other Disease ☐ - [60] Root ☐ - [61] Foliage ☐ - [62] Decays ☐ - [63] Canker ☐ - [64] Other Mechanical ☐ - [70] Blowdown ☐ - [71] Thinning ☐ - [72] Logging ☐ - [73] Drought ☐ - [74] Flood Other ☐ - [75] Hail ☐ - [76] Snow ☐ - [77] Frost ☐ - [78] Wind ☐ - [79] Fire Other ☐ - [80] Herbicide ☐ - [81] Air Pollution ☐ - [82] Salt ☐ - [83] Animal ☐ - [84] Bird If "other" & known identify: _____ If "other" & known identify: _____			
17. DAMAGE SYMPTOMS (Enter any pertinent information to indicate severity of damage or symptoms to help identify causal agent. Use TABLE I on instruction sheet above as an aid in describing symptoms.)			
PART B - TO BE COMPLETED BY FOREST SERVICE ONLY			
1. IDENTIFICATION OF DISEASE (Reply by Entomologist/Pathologist) 			
2. INFORMATION REPORTED (X Appropriate Box) ☐ Reared/Cultured ☐ Sample Damage - Resubmit ☐ Sent out for Identification			
3. REPORTED BY (Signature) _____		4. DATE _____	5. REPORT NUMBER _____

Previous editions of this form are obsolete.

5200-1 (3/78)
253-174

BIOLOGICAL EVALUATIONS COMPLETED DURING 1978

BY THE

FOREST INSECT AND DISEASE MANAGEMENT STAFF (R-2)

<u>REPORT TITLE</u>	<u>FI&DM FILE DESIGNATION</u>
Mountain Pine Beetle, Bighorn National Forest and adjacent BLM, State and Private Lands, Wyoming	R2-78-1
Mountain Pine Beetle, Shoshone National Forest, BLM, State and Private Lands, South Pass and Atlantic Cities, Wyoming	R2-78-2
Mountain Pine Beetle, Black Hills of South Dakota and Wyoming, Black Hills National Forest and adjacent Federal, State and private lands of South Dakota and Wyoming	R2-78-3
Insect and Disease Conditions of Pinyon Pine and Utah Juniper in Mesa Verde National Park, Colorado	R2-78-4
Mountain Pine Beetle, Evaluation of the Proposed Beulah Cooperative Demonstration Area, Pike and San Isabel National Forests	R2-78-5
Dwarf mistletoe surveys, Arapaho and Roosevelt National Forests, Redfeather Ranger District	R2-78-6
Western Spruce Budworm, Estes Valley, Colorado	R2-78-7
Western Spruce Budworm, San Juan, Pike and San Isabel, Arapaho and Roosevelt National Forests	R2-78-8

TECHNICAL REPORTS COMPLETED SINCE 1976
BY THE
FOREST INSECT AND DISEASE MANAGEMENT STAFF (R-2)

<u>REPORT TITLE</u>	<u>FI&DM FILE DESIGNATION</u>
Tree Hazards: Recognition and Reduction in Recreation Sites February 1976 (Revised April 1978)	R2-1
Soil and Water Quality in Relation to Lodgepole Pine Culture at Mt. Sopris Nursery February 1976	R2-2
Mycorrhizal Inoculation of Container Grown Ponderosa Pine Seedlings May 1976	R2-3
Dwarf Mistletoe as a Predisposing Factor for Mountain Pine Beetle Attack of Ponderosa Pine in the Colorado Front Range August 1976	R2-4
UNASSIGNED	R2-5
Parasitism of Douglas-Fir Tussock Moth Eggs in Denver November 1976	R2-6
Herbicide Testing at Mt. Sopris Tree Nursery November 1976	R2-7

REPORT TITLE

FI&DM FILE
DESIGNATION

Sodium Fluoraluminate as a Pesticide for
Controlling Western Spruce Budworm
(*Choristoneura occidentalis* Free.)
December 1976

R2-8

Management Guidelines for Lodgepole Pine Stands
Infected with Comandra Blister Rust and Dwarf
Mistletoe
June 1977

R2-9

Silvicultural Control of Dwarf Mistletoe in Young
Lodgepole Pine Stands
June 1977

R2-10

Guidelines for Estimating the Economic Benefits
of Mountain Pine Beetle Control Projects
June 1977

R2-11

Ground Tests with Several Insecticides Against the
Douglas-fir Tussock Moth in New Mexico
November 1977

R2-12

The Status of White Pine Blister Rust on Limber
Pine and Whitebark Pine in Wyoming
July 1978

R2-13

Effects of Thinning and Pruning on the Incidence
of Dwarf Mistletoe in Lodgepole Pine
July 1978

R2-14

A Pilot Survey to Measure Annual Mortality of
Ponderosa Pine by the Mountain Pine Beetle
in the Black Hills of South Dakota and Wyoming
January 1979

R2-15

REPORT TITLE

FI&DM FILE
DESIGNATION

Fungicidal Tolerance of *Botrytis cinerea*
October 1978

R2-16

Fomes annosus on White Fir in Colorado
October 1978

R2-17

Mycorrhizal Inoculation of Container-Grown
Engelmann Spruce and Lodgepole Pine
November 1978

R2-18

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<i>Ceratocystis minor</i> (Hedge.) Hunt	12
<i>Ceratocystis ulmi</i> (Buism.) C. Mor.	15
<i>Cercospora sequoiae</i> (E. & E.)	23
<i>Chrysomyxa arctostaphyli</i> Diet.	18
<i>Coccomyces lutescens</i> Higg.	21
Comandra blister rust	4, 12
Cottonwood leaf rust	19
<i>Cronartium comandrae</i> Peck.	12
<i>Cryptosphaeria</i> spp.	23
Cytospora canker	4, 14
<i>Cytospora chrysosperma</i> (Pers.) F.	15
Damping-off	22
<i>Diplodia pinea</i> (Desm.) Kickx.	18, 21
Diplodia tip blight	4, 18, 21
<i>Dothiora polyspora</i> Shear & David	23
<i>Dothiorella</i> spp.	23
<i>Dothistroma pini</i> Hulb.	18
Dutch elm disease	4, 15, 16
<i>Endocronartium harknessii</i> (J. P. Moore) Y. Hirat.	14
<i>Erwinia amylovora</i> (Burr.) Winsl.	23
Fir broom rust	18
<i>Fomes annosus</i> (Fr.) Cke.	16
<i>Fomes fraxinophilus</i> (Peck) Sacc.	14
<i>Fusarium</i> spp.	22, 23

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<i>Gnomonia leptostyla</i> Les. & deNot.	19
<i>Gnomonia platani</i> Edg.	23
<i>Gnomonia quercina</i> Kleb.	23
<i>Gnomonia ulmea</i> (Schw. ex Fr.) Thuem.	23
Green ash heartrot	4
Grey mold	21
<i>Gymnosparangium juniperi - virginianae</i> Schw.	23
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<i>Lophodermella arcuata</i> (Darker) Daner	19
<i>Lophodermium</i> spp.	19
<i>Marssonina populi</i> (Lib.) Magn.	23
<i>Melampsora medusae</i> Thum.	19
<i>Melampsorella caryophyllacearum</i> Schroet.	18
<i>Mycosphaerella</i> spp.	23
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<i>Phoma</i> spp.	23
<i>Phomopsis juniperovora</i> Hahn.	23
<i>Phyllosticta</i> spp.	23
<i>Physalospora miyabeana</i> Fuku.	23
<i>Phytophthora cactorum</i> (Leb. & Cohn.)	23
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<i>Puccinia peridermiospora</i> (Ell. & Tr.)	23
<i>Pythium</i> spp.	22
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<i>Rhizosphaera kalkhoffii</i> Bub.	19
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<i>Septoria musiva</i> Pk.	23
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Spruce broom rust	18
Spruce needlecast	19
<i>Taphrina caerulescens</i> (Mont. & Desm.) Tul.	23
<i>Venturia populina</i> (Vuill.)	23
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